IFW 1775

PTO/SB/21 (09-06)
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	10/551,873
Filing Date	September 30, 2005
First Named Inventor	Joseph Emmanual Zarb
Art Unit	1775
Examiner Name	
Attorney Docket Number	BALDS2.062APC (131279-1050)
Total Number of Pages in This Submission	14

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
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- ☐ Information Disclosure Statement
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Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Gardere Wynne Sewell LLP		
Signature	Monique A. Vander Molen		
Printed name	Monique A. Vander Molen		
Date	January 8, 2007	Reg. No.	53,716

CERTIFICATE OF TRANSMISSION/MAILING

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Signature	Anne Ziegler		
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Attorney Docket No. 131279-1050

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Joseph Emmanual Zarb et al.
Application No.:	10/551,873
Filing Date:	September 30, 2005
Examiner:	
Art Unit:	1775
For:	A Durable High Performance Fibre Cement Product And Method Of Manufacture

Certificate of Mailing under 37 CFR 1.8

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUBMISSION OF PRIORITY DOCUMENT

Dear Sir:

Applicants hereby submit a certified copy of the original foreign application from which the above-identified application claims a right of priority in accordance with U.S.C. §119(b)(3). The certification was made by the foreign intellectual property authority in which the foreign application was filed and shows the date of the application and filing of the specification and papers.

Respectfully submitted,
GARDERE WYNNE SEWELL LLP

Date: January 8, 2007

Monique A. Vander Molen
Monique A. Vander Molen
Registration No. 53,716
AGENT FOR APPLICANTS

1601 Elm Street, Suite 3000
Dallas, Texas 75201-4761
(214) 999-4330 – Telephone
(214) 999-3623 – Facsimile

Australian Government

Patent Office
Canberra

I, JANENE BRYDE, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003901529 for a patent by JAMES HARDIE RESEARCH PTY LIMITED as filed on 31 March 2003.

I further certify that the above application is now proceeding in the name of JAMES HARDIE INTERNATIONAL FINANCE B.V. pursuant to the provisions of Section 113 of the Patents Act 1990.

COMMONWEALTH OF AUSTRALIA
AUSTRALIA
PATENT OFFICE

WITNESS my hand this
Twentieth day of November 2006

J. K. Bryde

JANENE BRYDE
TEAM LEADER EXAMINATION
SUPPORT AND SALES

CERTIFIED COPY OF
PRIORITY DOCUMENT

AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:-

"A DURABLE HIGH PERFORMANCE FIBRE CEMENT PRODUCT AND METHOD OF MAKING THE SAME"

The invention is described in the following statement:-

FIELD OF THE INVENTION

The present invention relates to improved high performance preferably compressed fibre cement products having a reduced propensity to carbonation or differential carbonation, and hence increased durability, and to methods of making those products.

The invention has been developed for use initially in relation to external building cladding panels and will be described hereinafter with particular reference to this preferred field. However, it will be appreciated that the invention is equally applicable to other fibre reinforced cementitious products where improved weathering resistance and durability are important.

BACKGROUND OF THE INVENTION

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

Fibre reinforced cement (FRC) products are increasingly being used in building applications and in an ever increasing range of climatically different geographical regions. Such products have gained favour for their inherent fire, water, pest and mould resistance, as well as general affordability, which makes them particularly suitable for use in meeting commercial as well as residential building codes.

However, as with timber and other conventional building materials, exposure to the elements inevitably causes chemical changes in the FRC products over time. This is due in a significant part to the effect of atmospheric carbon dioxide on the cementitious product resulting from a process generally referred to as carbonation.

A growing use of FRC is in external and internal cladding panels which are manufactured by applying a customised finish to the front surface of an untreated "FRC" board. Such finishes may include various coatings, vinyl films, laminates or the like depending on the final appearance that is required.

While manufacturers of the FRC products clearly recommend that the rear mounting surfaces of such panels be sealed appropriately, this is not always done, and even when it is the FRC manufacturer has no control on the quality of any hidden face sealing that may be applied.

As a result of the above installation practices, some portions of an FRC product may carbonate at different rates depending on the degree of exposure and the integrity of sealers or other surface treatments. When different portions of the same FRC product carbonate at different rates, internal stresses develop. If these stresses are significant enough they can manifest themselves visually in the form of surface cracking of the panels and/or warping and the like.

While the carbonation process can be controlled to some degree by careful and usually expensive treatment of the FRC products during conversion of the bare board base panel product into a customised cladding sheet, or even more commonly as an additional coating or sealing process on site, it is hard to ensure consistent quality and outcome of these subsequent treatments. In addition, the processes involved are time and labour intensive. Similarly, other prior art procedures involving the lamination to a rear surface of base board of a resin sheet prior to customisation or installation, is unlikely to be commercially viable as the process would be costly, time consuming and limit the subsequent uses to which the resulting FRC board could usefully be employed.

It is an object of the present invention to provide a high performance compressed fibre cement product and methods of making that product which overcome or ameliorate at least one or more of the above discussed disadvantages of the prior art.

DISCLOSURE OF THE INVENTION

According to a first aspect of the invention there is provided an engineered high performance fibre cement product having a reduced propensity to carbonation or differential carbonation when compared to existing fibre cement products.

In a first preferred form, the product is engineered to have a predetermined permeability to thereby control the rate of carbonation and/or the carbonation gradient through the product.

In a first variation of this first preferred form, the product is configured to define at least one exposed surface to which a customised external finish is to be separately applied and a mounting surface, wherein a carbonation reducing sealer is applied to said mounting surface.

In a second variation of this first preferred form, the product is configured to have a structure that results in a permeability profile that produces a relatively even carbonation gradient through the product. This may be achieved by varying product density.

In a third variation of this first preferred form, the product permeability may be varied by varying the permeability profile of the product as a whole, and by applying a carbonation reducing sealer to at least one mounting surface.

In a second preferred form, the product is engineered to have a different chemical composition that is selected to reduce its propensity to carbonation.

In a first variation of this second preferred form, the FRC formulation has a dry weight basis cement to silica ratio of between 0.29 to 0.51.

More preferably, the dry weight basis cement to silica ratio is between 0.36 and in the most preferred form as used for cladding panels, is approximately 0.39.

According to a second aspect of the invention there is provided a method of making a manufacturer pre-treated durable high performance compressed fibre cement product, the method comprising steps of:

(a) forming by conventional processes a green fibre cement product configured to define at least one exposed surface and a mounting surface;

(b) compressing said formed green product;

(c) curing the compressed product in an autoclave; and

(d) applying a carbonation reducing sealer coating to at least said mounting surface.

Preferably the product is a sheet product configured for use as an exterior cladding panel and the carbonation reducing sealer is a UV sealer which is preferably applied to at least the back face which forms the mounting surface.

In a more preferred embodiment, the sealer is applied to all surfaces.

Desirably, the preferred UV sealer coating is a co-polymer acrylic sealer.

According to a third aspect of the invention, there is provided a durable high performance compressed fibre cement product made in accordance with the method of the fifth aspect of the invention.

According to an fourth aspect of the invention there is provided a method of making a durable high performance compressed fibre cement product, the method comprising the steps of:

(a) forming by conventional processes a green fibre cement product configured to define at least one exposed surface and a mounting surface;

(b) compressing said formed green product; and

(c) curing the compressed product in an autoclave;

wherein step (b) is controlled such that the cured product exhibits a reduced carbonation gradient through its outer surfaces and internal body portions.

In a preferred form, the method further comprises the additional step of subsequently applying a carbonation reducing sealer, or more preferably a UV cured sealer coating to at least said mounting surface.

According to a fifth aspect of the invention there is provided a durable high performance compressed fibre cement product made in accordance with the method of the ninth aspect of the invention.

According to a sixth aspect of the invention, there is provided a method of making a durable high performance compressed fibre cement product, the method comprising the steps of:

(a) mixing a wet fibre cement formulation having a dry weight basis cement silica ratio of between 0.29 to 0.51;

(b) forming from said mixed formulation a green product having one or more outer surfaces and an internal body portion;

(c) compressing said formed product; and

(d) curing the formed and compressed product in an autoclave.

In a preferred form, the method further comprises the step of applying a carbonation reducing sealer, or more preferably a UV cured sealer coating to one or more of said outer surfaces.

Details of additional mix additives and preferred full compositions and ranges are set out in the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred form of the invention will now be described, by way of example only, with reference to the incorporated tables and accompanying drawing in which:

Figure 1 is a flow chart showing a typical method of making a high performance compressed product in accordance with various aspects of the invention.

PREFERRED EMBODIMENTS OF THE INVENTION

The present invention has been developed primarily for use in the manufacture of high performance compressed fibre cement sheets specifically configured for use as external or internal building cladding and lining panels and will be described hereinafter with reference to this application.

Referring to figure 1, there is shown a flow chart 1 of a typical manufacturing process that is suitable for use with preferred forms of the invention configured for producing building cladding panels. Referring to this flow chart, it can be seen that the first step 2 is the manufacture of an FRC green sheet, which in preferred forms is made from a fibre cement composition that falls generally within the ranges set out in the table below.

Dry Ingredients	**Acceptable range (% by dry weight)**	**Preferred range (% by dry weight)**	**Optimal formula (% by dry weight)**
Cement	20 – 30%	23.5 – 26.5%	25.0%
Silica	58.5 – 68.5%	62 – 65%	63.5%
Pulp	5.5 – 10.5%	7 – 9 %	8.0%
Additives	2 – 5%	2.5 – 4.5%	3.5%
	Acceptable range	**Preferred range**	**Optimal ratio**

Cement:Silica	.292 -- .513	.362 -- .427	.394

This preferred composition has a reduced cement to silica ratio when compared with at least some other prior art formulations, the reduced cement component contributing to an overall reduction in carbon dioxide reactions within the finished product. The cement is typically ordinary Portland cement type 1 and the silica can be any suitable silica such as 200G milled quartz. Preferred pulps include various forms of cellulose fibres such as hammer-milled Kraft pulp. It should also be noted that optional additional additives can be incorporated in to the composition including viscosity enhancing agents, density modifiers, dispersing agents, and fly ash etc, as required.

In the preferred methods, the sheets are produced using the Hatschek process in the conventional manner well known to those skilled in the art. The Hatschek process uses a rotating drum sieve arrangement to deposit a plurality of layers of de-watered slurry onto an absorbent conveyer until the desired sheet thickness has been achieved.

The preferred green sheet manufacturing process referenced in the flow chart 1 is set to produce a plurality of green sheets of a particular size which are then stacked one upon another and then optionally conveyed to a pressing station. At the pressing station, the sheet size is identified as shown in step 3. Working for example within a preferred compression pressure range for cladding panels of 1850 mm x 1250 mm of approximately 10 MPa to 15 MPa, the press is programmed to take into account the sheet size and the stack height and the products are pressed within the pressure targets as shown in steps 4 to 7. This pressure is maintained for a predetermined time period as determined by trial experiment to achieve the desired outcomes in the final product.

After pressing, the compressed green products are cured in an autoclave as set out in claim 8 in the conventional manner.

When curing has been completed (step 9), the sheets are typically cut to size (as in step 10) and the edges are finished by passing through a conventional sheet finishing line where they are trimmed to size with an edge router to exact dimensions. The finished FRC sheets are placed in a stack as they come off the sheet finishing line. Optionally a carbonation reducing sealer, which is preferably a UV curable acrylic sealer, can be applied to the edges of each FRC before it leaves the sheet finishing line.

In some preferred forms of the invention, the finished FRC sheet is then fully coated with a sealer of the same kind as shown in step 10. This may be done by first manually roll coating or spraying the sealer on the edges of the stack of FRC sheets and then individually roll coating the sealer on the face and back of an FRC sheet using a conventional roll coater. Typically, a stack of 16 sheets is edge coated at one time to maximise efficiency, but to prevent drying before the FRC sheets go through the roll coater and are cured. Preferably, the coating thickness is in the range of 15 to 50 microns.

Finally, where the applied carbonation reducing sealer is a UV sealer, the FRC sheet is then cured with conventional UV light at a suitable predetermined intensity and duration as noted in step 13. The UV lights preferably shine above the FRC sheet and through a 300 to 400 mm gap in the conveyor to cure the back and edges of the FRC sheet at the same time. The intensity of the UV lights needs to be regularly monitored to maintain consistent curing. If the intensity of the light subsides, the curing isn't as strong which could lead to product imperfections.

It will be appreciated that the invention as described illustrates numerous ways in which an FRC product of reduced propensity to carbonation or differential carbonation and hence improved durability can be produced. For example, the reduced cement to silica ratio generally reduces carbon dioxide reactions within the product, thereby minimising any differential carbonation that may apply across various sheet boundaries and through the final sheet itself.

Similarly, it is thought that by controlling permeability and rigidity (as maybe affected by density), you can control carbonation gradients across a sheet, particularly where the various surfaces may have different levels and types of sealing.

Finally, the factory application of a sealer, and more particularly a carbonation reducing sealer such as an acrylic UV curable sealer, to at least the mounting surface of the panels in a controlled fashion, ensures that there is no risk of the panels being mounted without adequate sealing on the mounting surface, thereby again reducing the potential carbonation differential of the finished panel once it has been installed. There is the added advantage with original manufacturer pre-sealing of increasing the longevity of the base board during transport and storage. It also makes it significantly easier for cladding panel finishers and installers to apply additional coatings and the like. Certainly, sealing on all six surfaces of a panel greatly reduces the chance of severe differential carbonation across a panel, particularly as can occur when one or more sides are left untreated.

It is suggested that each of the above discussed process steps and features separately define inventive methods of making improved compressed FRC compressed products. It is also suggested that when these process steps and features are combined, which can be done in numerous different ways, there is a synergistic interaction that

enables production of products having vastly superior performance characteristics over the prior art.

Finally, it will be appreciated by those skilled in the art that while the inventive aspects are particularly suited to FRC compressed sheeting and panels, they are equally applicable to other FRC products. Similarly, while the preferred examples illustrate particular compositions and pressure ranges and sealants, the invention may be embodied in many other forms to achieve the same advantageous results.

DATED this 31st Day of March, 2003
BALDWIN SHELSTON WATERS
Attorneys for:
JAMES HARDIE RESEARCH PTY LIMITED

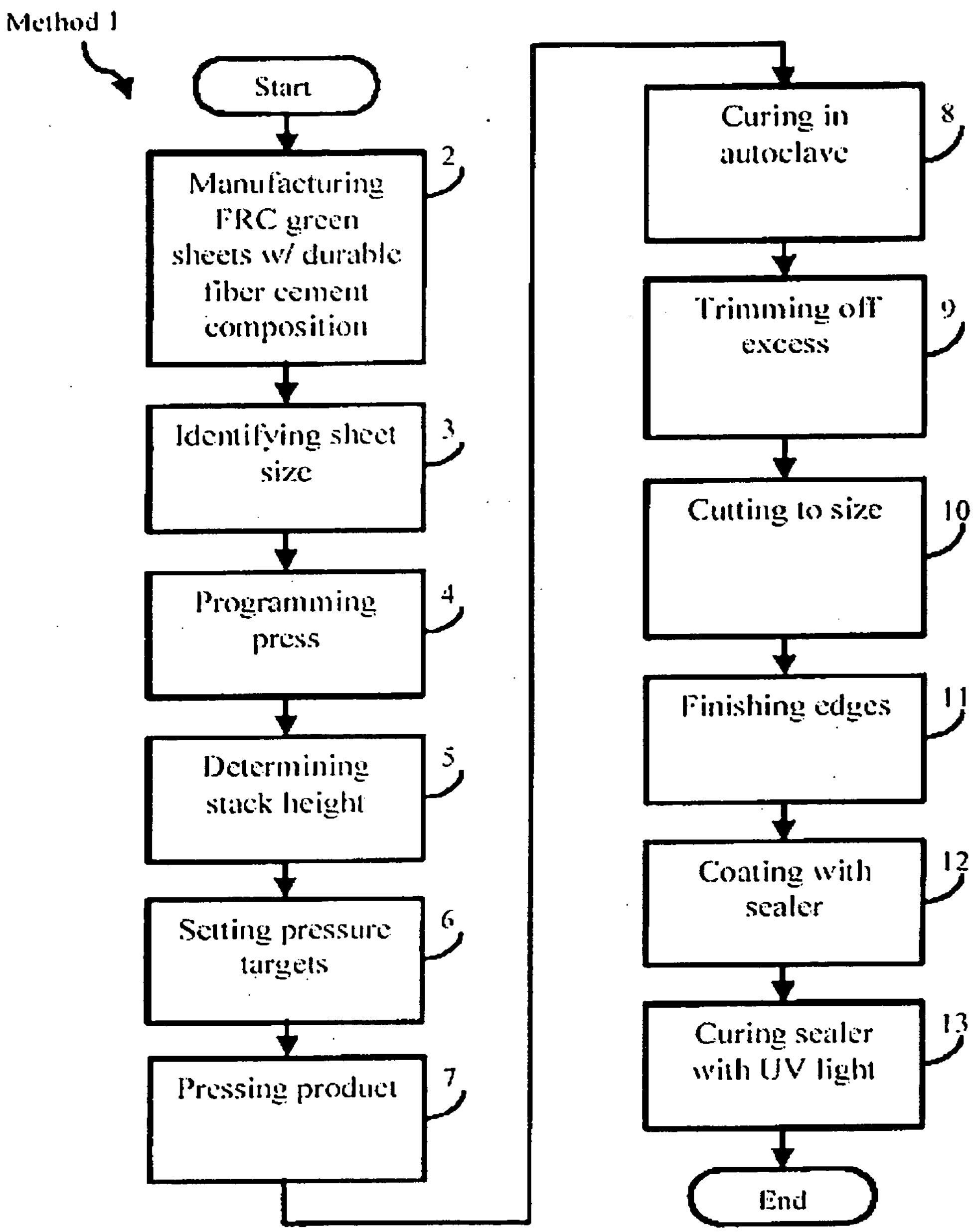
Method 1
Start
Manufacturing FRC green sheets w/ durable fiber cement composition
2
Identifying sheet size
3
Programming press
4
Determining stack height
5
Setting pressure targets
6
Pressing product
7
Curing in autoclave
8
Trimming off excess
9
Cutting to size
10
Finishing edges
11
Coating with sealer
12
Curing sealer with UV light
13
End

FIG. 1